

UNIT TERMINAL OBJECTIVE

- 6-1.1 At the completion of this unit, the paramedic student will be able to integrate pathophysiological principles and assessment findings to formulate a field impression and implement a treatment plan for a neonatal patient.

COGNITIVE OBJECTIVES

At the completion of this unit, the paramedic student will be able to:

- 6-1.2 Define the term newborn.(C-1)
 - 6-1.3 Define the term neonate. (C-1)
 - 6-1.4 Identify important antepartum factors that can affect childbirth. (C-1)
 - 6-1.5 Identify important intrapartum factors that can term the newborn high risk. (C-1)
 - 6-1.6 Identify the factors that lead to premature birth and low birth weight newborns. (C-1)
 - 6-1.7 Distinguish between primary and secondary apnea. (C-3)
 - 6-1.8 Discuss pulmonary perfusion and asphyxia. (C-1)
 - 6-1.9 Identify the primary signs utilized for evaluating a newborn during resuscitation. (C-1)
 - 6-1.10 Formulate an appropriate treatment plan for providing initial care to a newborn. (C-3)
 - 6-1.11 Identify the appropriate use of the APGAR score in caring for a newborn.(C-1)
 - 6-1.12 Calculate the APGAR score given various newborn situations. (C-3)
 - 6-1.13 Determine when ventilatory assistance is appropriate for a newborn. (C-1)
 - 6-1.14 Prepare appropriate ventilation equipment, adjuncts and technique for a newborn. (C-1)
 - 6-1.15 Determine when chest compressions are appropriate for a newborn. (C-1)
 - 6-1.16 Discuss appropriate chest compression techniques for a newborn. (C-1)
 - 6-1.17 Assess patient improvement due to chest compressions and ventilations. (C-1)
 - 6-1.18 Determine when endotracheal intubation is appropriate for a newborn. (C-1)
 - 6-1.19 Discuss appropriate endotracheal intubation techniques for a newborn. (C-1)
 - 6-1.20 Assess patient improvement due to endotracheal intubation. (C-1)
 - 6-1.21 Identify complications related to endotracheal intubation for a newborn. (C-1)
 - 6-1.22 Determine when vascular access is indicated for a newborn. (C-1)
 - 6-1.23 Discuss the routes of medication administration for a newborn. (C-1)
 - 6-1.24 Determine when blow-by oxygen delivery is appropriate for a newborn. (C-1)
 - 6-1.25 Discuss appropriate blow-by oxygen delivery devices and technique for a newborn. (C-1)
 - 6-1.26 Assess patient improvement due to assisted ventilations. (C-1)
 - 6-1.27 Determine when an orogastric tube should be inserted during positive-pressure ventilation. (C-1)
 - 6-1.28 Discuss the signs of hypovolemia in a newborn. (C-1)
 - 6-1.29 Discuss the initial steps in resuscitation of a newborn. (C-1)
 - 6-1.30 Assess patient improvement due to blow-by oxygen delivery. (C-1)
 - 6-1.31 Discuss the effects maternal narcotic usage has on the newborn. (C-1)
 - 6-1.32 Determine the appropriate treatment for the newborn with narcotic depression. (C-1)
 - 6-1.33 Discuss appropriate transport guidelines for a newborn. (C-1)
 - 6-1.34 Determine appropriate receiving facilities for low and high risk newborns. (C-1)
 - 6-1.35 Describe the epidemiology, including the incidence, morbidity/ mortality, risk factors and prevention strategies for meconium aspiration. (C-1)
 - 6-1.36 Discuss the pathophysiology of meconium aspiration. (C-1)
 - 6-1.37 Discuss the assessment findings associated with meconium aspiration. (C-1)
 - 6-1.38 Discuss the management/ treatment plan for meconium aspiration. (C-1)
 - 6-1.39 Describe the epidemiology, including the incidence, morbidity/ mortality, risk factors and prevention strategies for apnea in the neonate. (C-1)
 - 6-1.40 Discuss the pathophysiology of apnea in the neonate. (C-1)
 - 6-1.41 Discuss the assessment findings associated with apnea in the neonate. (C-1)

Special Considerations: 6

Neonatology: 1

- 6-1.42 Discuss the management/ treatment plan for apnea in the neonate. (C-1)
 - 6-1.43 Describe the epidemiology, pathophysiology, assessment findings, management/ treatment plan for diaphragmatic hernia. (C-1)
 - 6-1.44 Describe the epidemiology, including the incidence, morbidity/ mortality and risk factors for bradycardia in the neonate. (C-1)
 - 6-1.45 Discuss the pathophysiology of bradycardia in the neonate. (C-1)
 - 6-1.46 Discuss the assessment findings associated with bradycardia in the neonate. (C-1)
 - 6-1.47 Discuss the management/ treatment plan for bradycardia in the neonate. (C-1)
 - 6-1.48 Describe the epidemiology, including the incidence, morbidity/ mortality and risk factors for premature infants
 - 6-1.49 Discuss the pathophysiology of premature infants. (C-1)
 - 6-1.50 Discuss the assessment findings associated with premature infants. (C-1)
 - 6-1.51 Discuss the management/ treatment plan for premature infants. (C-1)
 - 6-1.52 Describe the epidemiology, including the incidence, morbidity/ mortality and risk factors for respiratory distress/ cyanosis in the neonate. (C-1)
 - 6-1.53 Discuss the pathophysiology of respiratory distress/ cyanosis in the neonate. (C-1)
 - 6-1.54 Discuss the assessment findings associated with respiratory distress/ cyanosis in the neonate. (C-1)
 - 6-1.55 Discuss the management/ treatment plan for respiratory distress/ cyanosis in the neonate.(C-1)
 - 6-1.56 Describe the epidemiology, including the incidence, morbidity/ mortality and risk factors for seizures in the neonate. (C-1)
 - 6-1.57 Discuss the pathophysiology of seizures in the neonate. (C-1)
 - 6-1.58 Discuss the assessment findings associated with seizures in the neonate. (C-1)
 - 6-1.59 Discuss the management/ treatment plan for seizures in the neonate. (C-1)
 - 6-1.60 Describe the epidemiology, including the incidence, morbidity/ mortality and risk factors for fever in the neonate. (C-1)
 - 6-1.61 Discuss the pathophysiology of fever in the neonate. (C-1)
 - 6-1.62 Discuss the assessment findings associated with fever in the neonate. (C-1)
 - 6-1.63 Discuss the management/ treatment plan for fever in the neonate. (C-1)
 - 6-1.64 Describe the epidemiology, including the incidence, morbidity/ mortality and risk factors for hypothermia in the neonate. (C-1)
 - 6-1.65 Discuss the pathophysiology of hypothermia in the neonate. (C-1)
 - 6-1.66 Discuss the assessment findings associated with hypothermia in the neonate. (C-1)
 - 6-1.67 Discuss the management/ treatment plan for hypothermia in the neonate. (C-1)
 - 6-1.68 Describe the epidemiology, including the incidence, morbidity/ mortality and risk factors for hypoglycemia in the neonate. (C-1)
 - 6-1.69 Discuss the pathophysiology of hypoglycemia in the neonate. (C-1)
 - 6-1.70 Discuss the assessment findings associated with hypoglycemia in the neonate. (C-1)
 - 6-1.71 Discuss the management/ treatment plan for hypoglycemia in the neonate. (C-1)
 - 6-1.72 Describe the epidemiology, including the incidence, morbidity/ mortality and risk factors for vomiting in the neonate (C-1)
 - 6-1.73 Discuss the pathophysiology of vomiting in the neonate. (C-1)
 - 6-1.74 Discuss the assessment findings associated with vomiting in the neonate. (C-1)
 - 6-1.75 Discuss the management/ treatment plan for vomiting in the neonate. (C-1)
 - 6-1.76 Describe the epidemiology, including the incidence, morbidity/ mortality and risk factors for diarrhea in the neonate. (C-1)
 - 6-1.77 Discuss the pathophysiology of in diarrhea the neonate. (C-1)
 - 6-1.78 Discuss the assessment findings associated with diarrhea in the neonate. (C-1)
 - 6-1.79 Discuss the management/ treatment plan for diarrhea in the neonate. (C-1)
 - 6-1.80 Describe the epidemiology, including the incidence, morbidity/ mortality and risk factors for common birth injuries in the neonate. (C-1)

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Neonatology: 1

- 6-1.81 Discuss the pathophysiology of common birth injuries in the neonate. (C-1)
 - 6-1.82 Discuss the assessment findings associated with common birth injuries in the neonate. (C-1)
 - 6-1.83 Discuss the management/ treatment plan for common birth injuries in the neonate. (C-1)
 - 6-1.84 Describe the epidemiology, including the incidence, morbidity/ mortality and risk factors for cardiac arrest in the neonate. (C-1)
 - 6-1.85 Discuss the pathophysiology of cardiac arrest in the neonate. (C-1)
 - 6-1.86 Discuss the assessment findings associated with cardiac arrest in the neonate. (C-1)
 - 6-1.87 Discuss the management/ treatment plan for cardiac arrest in the neonate. (C-1)
 - 6-1.88 Discuss the pathophysiology of post arrest management of the neonate. (C-1)
 - 6-1.89 Discuss the assessment findings associated with post arrest situations in the neonate. (C-1)
 - 6-1.90 Discuss the management/ treatment plan to stabilize the post arrest neonate. (C-1)

AFFECTIVE OBJECTIVES

At the completion of this unit, the paramedic student will be able to:

- 6-1.91 Demonstrate and advocate appropriate interaction with a newborn/ neonate that conveys respect for their position in life. (A-3)
 - 6-1.92 Recognize the emotional impact of newborn/ neonate injuries/ illnesses on parents/ guardians. (A-1)
 - 6-1.93 Recognize and appreciate the physical and emotional difficulties associated with separation of the parent/ guardian and a newborn/ neonate. (A-3)
 - 6-1.94 Listen to the concerns expressed by parents/ guardians. (A-1)
 - 6-1.95 Attend to the need for reassurance, empathy and compassion for the parent/ guardian. (A-1)

PSYCHOMOTOR OBJECTIVES

At the completion of this unit, the paramedic student will be able to:

- 6-1.96 Demonstrate preparation of a newborn resuscitation area. (P-2)
 - 6-1.97 Demonstrate appropriate assessment technique for examining a newborn. (P-2)
 - 6-1.98 Demonstrate appropriate assisted ventilations for a newborn. (P-2)
 - 6-1.99 Demonstrate appropriate endotracheal intubation technique for a newborn. (P-2)
 - 6-1.100 Demonstrate appropriate meconium aspiration suctioning technique for a newborn. (P-2)
 - 6-1.101 Demonstrate appropriate insertion of an orogastric tube. (P-2)
 - 6-1.102 Demonstrate needle chest decompression for a newborn or neonate. (P-2)
 - 6-1.103 Demonstrate appropriate chest compression and ventilation technique for a newborn. (P-2)
 - 6-1.104 Demonstrate appropriate techniques to improve or eliminate endotracheal intubation complications. (P-2)
 - 6-1.105 Demonstrate vascular access cannulation techniques for a newborn. (P-2)
 - 6-1.106 Demonstrate the initial steps in resuscitation of a newborn. (P-2)
 - 6-1.107 Demonstrate blow-by oxygen delivery for a newborn. (P-2)

DECLARATIVE

- I.
 - Introduction
 - A. Newborn
 - 1. A recently born infant; usually considered the first few hours of life
 - B. Neonate
 - 1. Considered the first 28 days of life
 - II. General pathophysiology, assessment and management
 - A. Epidemiology
 - 1. Incidence
 - a. Approximately 6% of deliveries require life support
 - b. Incidence of complications increases as birth weight decreases
 - 2. Morbidity/ mortality
 - a. Neonatal mortality risk can be determined via graphs based on birth weight and gestational age
 - b. Resuscitation is required for about 80% of the 30,000 babies who weigh less than 1500 grams at birth
 - 3. Risk factors
 - a. Antepartum factors
 - (1) Multiple gestation
 - (2) Inadequate prenatal care
 - (3) Mother's age <16 or >35
 - (4) History of perinatal morbidity or mortality
 - (5) Post-term gestation
 - (6) Drugs/ medications
 - (7) Toxemia, hypertension, diabetes
 - b. Intrapartum factors
 - (1) Premature labor
 - (2) Meconium-stained amniotic fluid
 - (3) Rupture of membranes greater than 24 hours prior to delivery
 - (4) Use of narcotics within four hours of delivery
 - (5) Abnormal presentation
 - (6) Prolonged labor or precipitous delivery
 - (7) Prolapsed cord
 - (8) Bleeding
 - 4. Treatment strategies
 - a. Preparation of resuscitation equipment
 - b. Determine appropriate destination
 - B. Pathophysiology
 - 1. Transition from fetal to neonatal circulation
 - 2. Respiratory system must suddenly initiate and maintain oxygenation
 - 3. Infants are very sensitive to hypoxia
 - 4. Permanent brain damage will occur with hypoxemia
 - 5. Apnea in newborns
 - 6. Congenital anomalies
 - a. Diaphragmatic hernia
 - b. Choanal atresia
 - c. Pierre Robin Syndrome
 - d. Cleft lip

- C. Assessment

 1. Time of delivery
 2. Normal/ abnormal vital signs
 3. Airway and ventilation
 - a. Respiratory rate
 - b. Respiratory effort
 4. Circulation
 - a. Heart rate
 - (1) Normal
 - b. Color/ cyanosis
 - (1) Normal
 - (2) Central versus peripheral
 - (3) Mucosal membranes
 - c. End organ perfusion
 - (1) Compare strength of central pulses versus peripheral
 - (2) Capillary refill
 5. APGAR
 - a. Appearance - skin color
 - (1) Completely pink - 2
 - (2) Body pink, extremities blue - 1
 - (3) Blue, pale - 0
 - b. Pulse rate
 - (1) Above 100 - 2
 - (2) Below 100 - 1
 - (3) Absent - 0
 - c. Grimace - irritability
 - (1) Cries - 2
 - (2) Grimaces - 1
 - (3) No response - 0
 - d. Activity - muscle tone
 - (1) Active motion - 2
 - (2) Some flexion of extremities - 1
 - (3) Limp - 0
 - e. Respiratory - effort
 - (1) Strong cry - 2
 - (2) Slow and irregular - 1
 - (3) Absent - 0

D. Treatment

 1. Prior to delivery, prepare environment and equipment
 2. During delivery, suction mouth and nose as head delivers
 3. After delivery
 - a. Airway and ventilation
 - (1) Drying
 - (a) Head and face
 - (b) Body
 - (2) Warming
 - (a) Appropriate techniques
 - (3) Position
 - (4) Suction

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Special Considerations: 6

Neonatology: 1

- (a) Technique
 - i) Mouth first, than nares
 - ii) Nasal suctioning is a stimulus to breathe
 - (b) Equipment
 - i) Bulb suction
 - ii) Suction catheters
 - iii) Meconium aspirator
 - (5) Stimulation
 - (a) Flicking soles of feet
 - (b) Stroking back
 - (6) Blow-by oxygen
 - (a) Never withhold oxygen
 - (b) Oxygen should be warmed
 - (c) Use when
 - i) Newborn is cyanotic and
 - ii) Heart rate > 100 and
 - iii) Adequate respiratory rate and effort
 - (d) 5 liters/ minute maximum
 - i) Complications due to hypothermia
 - (e) Appropriate techniques
 - (7) Oral airways - rarely used for neonates
 - (a) Necessary to keep mouth open for ventilation
 - (b) Bilateral choanal atresia
 - (c) Pierre Robin Syndrome
 - (8) Bag-valve-mask
 - (a) Mask characteristics
 - i) Appropriate size
 - ii) Minimize dead-space
 - (b) Bag characteristics
 - i) Pop-off valve should be disabled
 - (c) Use when
 - i) Apneic
 - ii) Inadequate respiratory rate or effort
 - iii) Heart rate less than 100
 - (d) Technique
 - i) Initial ventilations require higher pressure to expand lungs
 - (9) Intubation
 - (a) Indications
 - i) Prolonged positive pressure ventilation
 - ii) Bag and mask ventilations ineffective
 - iii) Tracheal suctioning required
 - iv) Diaphragmatic hernia suspected
 - (b) Technique
 - i) Equipment
 - a) Suction equipment
 - b) Laryngoscope
 - c) Blades-straight
 - #1- full term
 - #0- preterm

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Special Considerations: 6

Neonatology: 1

- d) Endotracheal tubes
 - 2.5 to 4.0 mm ID
 - e) Shoulder roll
 - f) Adhesive tape
 - (c) Confirmation
 - i) Visualization
 - a) Tube passing through the cords
 - Vocal cord guide should stop at the level of the cords
 - b) Chest expansion with ventilation
 - ii) Auscultation
 - a) Laterally and high on the chest wall
 - b) Epigastric region
 - iii) Patient improvement
 - (d) PEEP
 - (10) Gastric decompression
 - (a) Abdominal distention is impeding ventilation
 - (b) Presence of diaphragmatic hernia
 - b. Circulation
 - (1) Vascular access
 - (a) Indications
 - i) To administer fluids
 - ii) To administer medications
 - (b) Peripheral vein cannulation
 - (c) Umbilical vein cannulation
 - (d) Intraosseous cannulation
 - (2) Chest compression (in addition to assisted ventilation with BVM)
 - (a) Indications
 - i) Heart rate less than 60
 - ii) Heart rate between 60 and 80 and not increasing with adequate oxygenation
 - (b) Technique
 - i) Two finger technique
 - ii) Thumb technique
 - (c) Rate
 - i) 120 per minute
 - (d) Depth
 - i) 1/2 - 3/4 inches
 - (e) Compression-to-ventilation ratio
 - i) 3 compressions to 1 ventilation
 - c. Pharmacological
 - (1) Bradycardia
 - (2) Low blood volume
 - (3) Respiration depression secondary to narcotics
 - (4) Metabolic acidosis
 - d. Non-pharmacological
 - (1) Temperature control
 - (2) Positioning
 - e. Transport consideration
 - (1) Rapid transportation of the distressed infant

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Special Considerations: 6

Neonatology: 1

- f. (2) Position newborn on their side to prevent aspiration
Psychological support/ communication strategies
(1) Allow healthy newborn to bond with mother if possible

III. Specific situations

- A. Meconium stained amniotic fluid

 1. Epidemiology
 - a. Incidence
 - (1) Approximately 10 - 15% of deliveries
 - (2) May occur either in utero or intrapartum
 - (3) Mostly in post-term and small-for-gestational-age newborns
 - b. Morbidity/ mortality
 - (1) High mortality
 - (2) Hypoxemia
 - (3) Aspiration pneumonia
 - (4) Pneumothorax
 - (5) Pulmonary hypertension
 - c. Risk factors
 - (1) Fetal distress during labor and delivery
 - (2) Post-term infants
 2. Anatomy and physiology review
 3. Pathophysiology
 - a. Hypoxia or physiologic cause
 - b. Aspiration of meconium stained amniotic fluid
 - (1) Airway obstruction
 - (a) Complete
 - i) Atelectasis
 - ii) Right-to-left shunt across the foramen ovale
 - (b) Incomplete
 - i) Ball valve type obstruction
 - ii) Developing pneumothorax
 - c. Patient deterioration
 - (1) Hypoxia
 - (2) Hypercapnia
 - (3) Acidosis
 4. Assessment findings
 - a. Thin and watery
 - b. Thick and particulate
 - (1) Dark green-black amniotic fluid
 5. Management considerations for thick or particulate meconium
 - a. Airway and ventilation
 - (1) Do not stimulate the infant to breathe
 - (2) Tracheal suction under direct visualization
 - (a) End point considerations
 - i) Airway is clear
 - ii) Infant breathes on own
 - iii) Bradycardia
 - (3) Ventilate with 100% oxygen
 - b. Circulation
 - (1) Assure adequate perfusion

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Neonatology: 1

- c. Pharmacological
 - (1) If hypotensive, administer fluid challenge
 - d. Non-pharmacological
 - (1) Needle decompression may be required
 - (2) Hypothermia prevention
 - e. Transport consideration
 - (1) Identify facility to handle high-risk newborn
 - f. Psychological support/ communication strategies
 - (1) Do not discuss "chances of survival" with family
 - (2) Explain what is being done for the newborn

B. Apnea in the neonate

 - 1. Epidemiology
 - a. Incidence
 - (1) Common finding in preterm infants
 - b. Morbidity/ mortality
 - (1) If prolonged, can lead to hypoxemia and bradycardia
 - c. Risk factors
 - (1) Prematurity
 - (2) In newborn, prolonged or difficult labor and delivery
 - (3) Drug exposure
 - 2. Anatomy and physiology review
 - 3. Pathophysiology
 - a. Usually due to hypoxia or hypothermia
 - b. May be due to other causes
 - (1) Narcotics or central nervous system depressant
 - (2) Airway and respiratory muscle weakness
 - (3) Oxyhemoglobin dissociation curve shift
 - (4) Septicemia
 - (5) Metabolic disorder
 - (6) Central nervous system disorders
 - 4. Assessment findings
 - a. Failure to breathe spontaneously after stimulation
 - b. Respiratory pauses greater than 20 seconds
 - 5. Management considerations
 - a. Airway and ventilation
 - (1) Stimulate the baby to breathe
 - (a) Flicking the soles of the feet
 - (b) Rubbing the back
 - (2) Ventilate with BVM
 - (a) Disable pop-off valve
 - (b) Subsequent ventilations with minimal pressure to cause chest rise
 - (3) Suction as needed
 - (4) Intubation
 - (a) Indications
 - i) Heart rate less than 60 with adequate BVM ventilation and chest compressions
 - ii) Prolonged positive-pressure ventilations
 - iii) Prolonged apnea
 - iv) Central cyanosis despite adequate ventilations

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Neonatology: 1

- (b) Complications

 - i) Tube dislodgement
 - ii) Tube occlusion by mucus or meconium
 - iii) Pneumothorax

b. Circulation

 - (1) Monitor heart rate continuously
 - (2) Circulatory access
 - (a) Umbilical vein cannulation in newborn
 - (b) Peripheral IV
 - (c) Intraosseous

c. Pharmacological

 - (1) Consider narcotic antagonists if narcotic administered within four hours of delivery
 - (2) NO narcotic antagonist should be utilized if mother is a drug abuser
 - (3) Consider dextrose (D10) administration if hypoglycemic

d. Non-pharmacological

 - (1) Hypothermia preventions

e. Transport consideration

 - (1) Identify facility to handle high-risk newborn

f. Psychological support/ communication strategies

 - (1) Relatively good outcome if treated early and aggressively
 - (2) Explain what is being done for the infant

C. Diaphragmatic hernia in the neonate

 1. Epidemiology
 - a. Incidence
 - (1) Occurs in 1 in 2200 live births
 - (2) Most commonly (90%) on the left side
 - b. Morbidity/ mortality
 - (1) Survival for infant who require mechanical ventilation in the first 18 to 24 hours of life is approximately 50%
 - (2) If no respiratory distress within the first 24 hours of life survival approaches 100%
 - c. Risk factors
 - (1) Bag and mask ventilation can worsen condition
 2. Anatomy and physiology review
 3. Pathophysiology
 - a. Abdominal contents are displaced into the thorax
 - b. Heart may be displaced
 4. Assessment findings
 - a. Little to severe distress
 - b. May have cyanosis unresponsive to ventilations
 - c. Scaphoid (flat) abdomen
 - d. Bowel sounds heard in chest
 - e. Heart sounds displaced to right
 5. Management considerations
 - a. Airway and ventilation
 - (1) Assure adequate oxygen
 - (2) Place an orogastric tube and apply low, intermittent suction
 - (3) Endotracheal intubation may be necessary
 - b. Circulation

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Neonatology: 1

- (1) Monitor heart rate continuously
 - c. Pharmacological
 - (1) None indicated for primary problem
 - d. Non-pharmacological
 - (1) Surgical repair required
 - e. Transport consideration
 - (1) Identify facility to handle high-risk newborn
 - f. Psychological support/ communication strategies
 - (1) Explain what is being done for the infant

D. Bradycardia in the neonate

 - 1. Epidemiology
 - a. Incidence
 - (1) Most commonly caused by hypoxia
 - (2) Increased intracranial pressure
 - (3) Hypothyroidism
 - (4) Acidosis
 - b. Morbidity/ mortality
 - (1) Minimal risk if hypoxia is corrected quickly
 - c. Risk factors
 - (1) Treatment via pharmacological measures alone
 - (2) Prolonged suction or airway instrumentation
 - 2. Anatomy and physiology review
 - 3. Pathophysiology
 - a. Primarily caused by hypoxia
 - 4. Assessment findings
 - a. Assess upper airway for obstruction
 - (1) Secretions
 - (2) Tongue and soft tissue positioning
 - (3) Foreign body
 - b. Assess patient for hypoventilation
 - c. Palpate umbilical stump or brachial artery
 - 5. Management considerations
 - a. Airway and ventilation
 - (1) Suction
 - (2) Positive pressure ventilation with 100% oxygen
 - (3) Endotracheal intubation
 - b. Circulation
 - (1) Heart rate less than 100
 - (a) BVM ventilation with 100% oxygen and reassess
 - (2) Heart rate less than 60
 - (a) Begin chest compressions
 - (3) Heart rate between 60 and 80 but not responding to assisted ventilations with BVM
 - (a) Begin chest compressions
 - (4) Discontinue chest compressions when heart rate reaches 100
 - c. Pharmacological
 - (1) Epinephrine
 - d. Non-pharmacological
 - (1) Maintain temperature
 - e. Transport consideration

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Neonatology: 1

- E. Premature infants

 1. Epidemiology
 - a. Incidence
 - (1) Born prior to 37 weeks gestation
 - (2) Weight ranges from .6-2.2 kg
 - b. Morbidity/ mortality
 - (1) Healthy premature infants weighing greater than 1700 g have a survivability and outcome approximately that of full-term infants
 - (2) Respiratory suppression
 - (3) Hypothermia risk
 - (4) Head/ brain injury
 - (a) Hypoxemia
 - (b) Change in blood pressure
 - (c) Intraventricular hemorrhage
 - (d) Fluctuations in serum osmolarity
 - c. Risk factors
 - (1) Mortality decreases weekly with gestation beyond the onset of viability (currently around 23-24 weeks of gestation)
 2. Anatomy and physiology review
 3. Pathophysiology
 - a. Retinopathy of prematurity
 - (1) Result of long term oxygen use
 - (2) Extreme prematurity
 - (3) Should not be a factor in short term management
 - (4) Hypoxemia causes irreparable brain damage
 4. Assessment findings
 - a. Degree of immaturity determines the physical characteristics
 - b. Generally a large trunk and short extremities
 - c. Skin is transparent and less wrinkles
 - d. Less subcutaneous fat
 5. Management considerations
 - a. Attempt resuscitation if the infant has any sign of life
 - b. Airway and ventilation
 - (1) Suction
 - (2) Assure adequate oxygenation
 - c. Circulation
 - (1) Chest compressions if indicated
 - d. Pharmacological
 - (1) Epinephrine
 - e. Non-pharmacological
 - (1) Maintain body temperature
 - f. Transport consideration
 - (1) Transport to a facility with special services for low birth weight newborns
 - g. Psychological support/ communication strategies
 - (1) Explain what is being done for the infant

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Neonatology: 1

- a. Incidence
 - (1) Prematurity is the single most common factor
 - (2) Occurs most frequently in infants less than 1200 grams and 30 weeks gestation
 - (3) Multiple gestations increase risk
 - (4) Prenatal maternal complications increase risk
 - b. Morbidity/ mortality
 - (1) Premature infants have an immature central respiratory control center
 - (2) Easily affected by environmental or metabolic changes
 - c. Risk factors
 - (1) Associated respiratory diseases/ complications affect oxygenation

2. Anatomy and physiology review

3. Pathophysiology

 - a. Lung or heart disease
 - b. Primary pulmonary hypertension
 - c. CNS disorders
 - d. Mucous obstruction of nasal passages
 - e. Spontaneous pneumothorax
 - f. Choanal atresia
 - g. Meconium aspiration
 - h. Amniotic fluid aspiration
 - i. Lung immaturity
 - j. Pneumonia
 - k. Shock and sepsis
 - l. Metabolic acidosis
 - m. Diaphragmatic hernia
 - n. Can lead to cardiac arrest

4. Assessment findings

 - a. Tachypnea
 - b. Paradoxical breathing
 - c. Periodic breathing
 - d. Intercostal retractions
 - e. Nasal flaring
 - f. Expiratory grunt

5. Management considerations

 - a. Airway and ventilation
 - (1) Suction
 - (2) High concentration oxygen
 - (3) BVM
 - (4) Consider intubation
 - b. Circulation
 - (1) Chest compressions if indicated
 - c. Pharmacological
 - (1) Sodium bicarbonate may be helpful for prolonged resuscitation per medical direction
 - (2) D10 administration if hypoglycemic
 - d. Non-pharmacological
 - (1) Maintain normal body temperature
 - e. Transport consideration
 - f. Psychological support/ communication strategies

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- G. Seizures in the neonate

 1. Epidemiology
 - a. Incidence
 - (1) Occur in a very small percentage of all newborns
 - b. Morbidity/ mortality
 - (1) Represent relative medical emergencies as they are usually a sign of an underlying abnormality
 - c. Risk factors
 - (1) Prolonged and frequent multiple seizures may result in metabolic changes and cardiopulmonary difficulties
 2. Anatomy and physiology review
 3. Pathophysiology
 - a. Types of seizures
 - (1) Subtle seizure
 - (a) Eye deviation, blinking, sucking, swimming movements of the arms, pedaling movements of the legs, apnea
 - (2) Tonic seizure
 - (a) Tonic extension of the limbs
 - (b) Less commonly, flexion of the upper extremities and extension of the lower extremities
 - (c) More common in premature infants, especially in those with intraventricular hemorrhage
 - (3) Multi focal seizure
 - (a) Clonic activity in one extremity
 - (b) Randomly migrates to another area of the body
 - (c) Occur primarily in full-term infants
 - (4) Focal clonic seizure
 - (a) Clonic localized jerking
 - (b) Occur in both full-term and premature infants
 - (5) Myoclonic seizure
 - (a) Flexion jerks of the upper or lower extremities
 - (b) May occur singly or in a series of repetitive jerks
 - b. Causes
 - (1) Hypoglycemia
 - (2) Other
 - (a) Hypoxic-ischemic encephalopathy
 - (b) Intracranial hemorrhage
 - (c) Metabolic disturbances
 - (d) Meningitis or encephalopathy
 - (e) Developmental abnormalities
 - (f) Drug withdrawal
 4. Assessment findings
 - a. Decreased level of consciousness
 - b. Seizure activity
 5. Management considerations
 - a. Airway and ventilation
 - (1) Maintain oxygen saturation
 - b. Circulation
 - c. Pharmacological

- (1) Consider D₁₀ for hypoglycemia
 - (2) Consider anticonvulsant
 - (3) Consider benzodiazepine for status epilepticus
 - d. Non-pharmacological
 - (1) Maintain normal body temperature
 - e. Transport consideration
 - (1) Identify facility to handle high-risk newborn
 - f. Psychological support/ communication strategies
 - (1) Explain what is being done for the infant

H. Fever in the neonate

 - 1. Epidemiology
 - a. Incidence
 - (1) Rectal temperature \geq 100.4 F (38.0 degrees C)
 - (2) Average normal temperature - 99.5 degrees F (37.5 degrees C)
 - b. Morbidity/ mortality
 - (1) Limited ability to control body temperature
 - c. Risk factors
 - (1) Dehydration may contribute to hyperthermia
 - 2. Anatomy and physiology review
 - 3. Pathophysiology
 - a. Increased use of glucose to maintain normal body temperature
 - b. Anaerobic metabolism results due to a lack of glucose
 - 4. Assessment findings
 - a. Mental status changes (irritability/ somnolence)
 - b. Decreased intake
 - c. Caretaker history
 - d. Feels warm
 - e. Observe patient for rashes, petechia
 - f. Term newborns will produce beads of sweat on their brow but not over the rest of their body
 - g. Premature infants will have no visible sweat
 - 5. Management considerations
 - a. Airway and ventilation
 - (1) Assure adequate oxygenation and ventilation
 - b. Circulation
 - (1) Perform chest compressions if indicated
 - c. Pharmacological
 - (1) Administration of antipyretic agent is questionable in the prehospital setting
 - d. Non-pharmacological
 - e. Transport consideration
 - f. Psychological support/ communication strategies
 - (1) Explain what is being done for the infant

I. Hypothermia in the neonate

 - 1. Epidemiology
 - a. Incidence
 - (1) Body temperature drops below 35 degrees C
 - b. Morbidity/ mortality
 - (1) Infants may die of cold exposure at temperatures adults find comfortable
 - c. Risk factors

Special Considerations: 6

Neonatology: 1

- (1) Four method of heat loss need to be controlled

 - Evaporation
 - Conduction
 - Convection
 - Radiation

2. Anatomy and physiology review

3. Pathophysiology

 - Increased surface-to-volume relation makes newborns extremely sensitive to environmental conditions, especially when they are wet after delivery
 - Can be an indicator of sepsis in the neonate
 - Increased metabolic demand can cause metabolic acidosis, pulmonary hypertension and hypoxemia

4. Assessment findings

 - Pale color
 - Cool to touch, particular in extremities
 - Acrocyanosis
 - Respiratory distress
 - Apnea
 - Bradycardia
 - Central cyanosis
 - Irritability initially
 - Lethargy in late stage
 - Generally do not shiver

5. Management considerations

 - Airway and ventilation
 - Assure adequate oxygenation and ventilation
 - Circulation
 - Perform chest compressions if indicated
 - Pharmacological
 - D10 if hypoglycemic
 - Warm IV fluids
 - Non-pharmacological
 - Environmental conditions should be 24 to 26.5 degrees C
 - Warm hands prior to touching patient
 - Transport consideration
 - Identify facility to handle high-risk newborn
 - Psychological support/ communication strategies
 - Explain what is being done for the infant

J. Hypoglycemia in the neonate

1. Epidemiology

 - Incidence
 - Blood glucose concentration should be determined on all sick infants
 - May be due to inadequate glucose intake or increased utilization of glucose
 - Morbidity/ mortality
 - Persistent low blood glucose levels may have catastrophic effects on the brain
 - Risk factors
 - Asphyxia, toxemia, smaller twin, CNS hemorrhage, sepsis

2. Anatomy and physiology review

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Special Considerations: 6

Neonatology: 1

3. Pathophysiology

 - A blood glucose screening test less than 45 mg/dl indicates hypoglycemia
 - Glycogen stores are sufficient to meet glucose requirements for 8 to 12 hours
 - Body releases counter-regulatory hormones including Glucagon, epinephrine, cortisol and growth hormone
 - Hormones may cause symptoms of hyperglycemia that last for several hours

4. Assessment findings

 - Twitching or seizures, limpness, lethargy, eye-rolling, high pitched cry, apnea, irregular respirations and possible cyanosis

5. Management considerations

 - Airway and ventilation
 - Assure adequate oxygenation and ventilation
 - Circulation
 - Perform chest compressions if indicated
 - Pharmacological
 - Administer D10
 - Non-pharmacological
 - Maintain normal body temperature
 - Transport consideration
 - Identify facility to handle high-risk newborn
 - Psychological support/ communication strategies
 - Explain what is being done for the infant

K. Vomiting in the neonate

 - Epidemiology
 - Incidence
 - Persistent vomiting is a warning sign
 - Vomiting mucous, occasionally blood streaked, in the first few hours of life is not uncommon
 - Morbidity/ mortality
 - Vomiting in the first 24 hours of life suggests obstruction in the upper digestive tract or increased intracranial pressure
 - Vomit containing dark blood is usually a sign of a life-threatening illness
 - Risk factors
 - Aspiration of vomitus can cause respiratory insufficiencies or obstruction of the airway
 - Anatomy and physiology review
 - Pathophysiology
 - Vomiting of non-bile-stained fluid
 - Anatomic or functional obstruction at or above the first portion of the duodenum
 - Gastroesophageal reflux
 - Vomiting of bile-stained fluid
 - Obstruction below the opening of the bile duct
 - Assessment findings
 - Distended stomach
 - Infection
 - Increased ICP
 - Drug withdrawal
 - Management considerations

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Special Considerations: 6

Neonatology: 1

- L.
 - a. Airway and ventilation
 - (1) Maintain a patent airway
 - (2) Suction/ clear vomitus from airway
 - (3) Assure adequate oxygenation
 - b. Circulation
 - (1) Bradycardia may be caused by vagal stimulus
 - c. Pharmacological
 - (1) Fluid administration may be required
 - d. Non-pharmacological
 - (1) Provide supportive measures
 - e. Transport consideration
 - (1) Place infant on side
 - (2) Identify facility to handle high-risk newborn
 - 6. Psychological support/ communication strategies
 - a. Explain what is being done for the infant

Diarrhea in the neonate

 - 1. Epidemiology
 - a. Incidence
 - (1) Normal - five to six stools per day, especially if breast feeding
 - b. Morbidity/ mortality
 - (1) Severe cases can cause dehydration
 - (2) Bacterial or viral infection may be involved
 - c. Risk factors
 - (1) Severe loss can cause electrolyte imbalance
 - 2. Anatomy and physiology review
 - 3. Pathophysiology
 - a. Gastroenteritis
 - b. Lactose intolerance
 - c. Phototherapy
 - d. Neonatal abstinence syndrome
 - e. Thyrotoxicosis
 - f. Cystic fibrosis
 - 4. Assessment findings
 - a. Loose stools
 - b. Decreased urinary output
 - c. Signs of dehydration
 - 5. Management considerations
 - a. Airway and ventilation
 - (1) Assure adequate oxygenation
 - b. Circulation
 - (1) Perform chest compressions if indicated
 - c. Pharmacological
 - (1) Fluid therapy may be indicated
 - d. Non-pharmacological
 - (1) BSI procedures
 - e. Transport consideration
 - (1) Identify facility to handle high-risk newborn
 - f. Psychological support/ communication strategies
 - (1) Explain what is being done for the infant

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Special Considerations: 6

Neonatology: 1

- d. (1) Provide if indicated
 - d. Non-pharmacological
 - (1) Provide supportive measures
 - e. Transport consideration
 - (1) Identify facility to handle high-risk newborn
 - f. Psychological support/ communication strategies
 - (1) Explain what is being done for the newborn

IV. Neonatal resuscitation and post resuscitation and stabilization

A. Neonatal cardiac arrest management

1. **Epidemiology**
 - a. Incidence
 - (1) Primarily related to hypoxia
 - b. Morbidity/ mortality
 - (1) Outcome is poor if interventions are not initiated quickly
 - (2) Increased likelihood of brain and organ damage
 - c. Risk factors
 - (1) Intrauterine asphyxia
 - (2) Prematurity
 - (3) Drugs administered to or taken by the mother
 - (4) Congenital neuromuscular diseases
 - (5) Congenital malformations
 - (6) Intrapartum hypoxemia
 2. Anatomy and physiology review
 3. Pathophysiology
 - a. Primary apnea
 - b. Secondary apnea
 - c. Bradycardia
 - d. Persistent fetal circulation
 - e. Pulmonary hypertension
 4. Assessment findings
 - a. Peripheral cyanosis
 - b. Inadequate respiratory effort
 - c. Ineffective or absent heart rate
 5. Management considerations
 - a. Airway and ventilation
 - (1) Assure adequate oxygenation and ventilation
 - (a) Blow-by oxygenation is required if peripheral cyanosis is present and despite adequate respiratory effort and heart rate greater than 100 beats/ min
 - (b) Ventilations are required if respiratory effort is inadequate, ineffective or absent or heart rate is less than 80 beats/ min
 - (c) Ventilate at a rate of 40 to 60 breaths per minute
 - (d) Administer a tidal volume sufficient to expand the chest
 - (e) Intubation required if bag-valve-mask ventilations are ineffective, tracheal suctioning is required or prolonged positive-pressure ventilation is necessary
 - b. Chest compressions are indicated if pulse is less than 60 beats/ minute, or between 60 and 80 beats/ minute and not improving despite assisted ventilations with BVM

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Special Considerations: 6

Neonatology: 1

- c. (1) Suction airway thoroughly
 - Circulation
 - (1) Perform chest compression
 - d. Pharmacological
 - (1) Epinephrine
 - (2) Normal saline or Ringer's lactate
 - (3) Sodium bicarbonate
 - (4) Naloxone
 - (5) Dextrose (D10)
 - e. Non-pharmacological
 - (1) Maintain normal body temperature
 - f. Transport consideration
 - (1) Identify facility to handle high-risk newborn
 - g. Psychological support/ communication strategies

Special Considerations: 6

Neonatology: 1

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